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Study of surface configuration of soft spherical shell under cylindrical indenters

Youssefian, Sina, s.uefian@gmail.com; Rahbar, Nima, Worcester Polytechnic Institute, United States

ABSTRACT

A combination of numerical and analytical studies has been used to investigate the large deformation of spherical elastic shells under different cylindrical indenters. The numerical results showed that a general correlation between nondimensional force and displacement can be found to capture the elastic response of spherical shells to the forces applied by different cylindrical indenters. This correlation is the same as that of a flat plate, up to a certain displacement and after this moment, the rigidity of the system decreases and follows another correlation. To find this moment, the configuration of the surface is needed to be determined. Considering the axisymmetric condition of the system, the configuration of the surface is considered as a 2D line comprises of a contacting region under stretching stresses and noncontacting region under bending stresses. The noncontacting region is divided into two parts. The first part that is bearing large stresses is projected as a polynomial of order of three and the second part that has smaller bending energies is consider as a curved-beam. Using geometric continuity and minimum energy of the system, the parameters associated with the configuration of the surface are found and verified by the numerical simulations. The displacement at which the rigidity decreases is obtained from this equation, and the general correlation between force and displacement is presented.